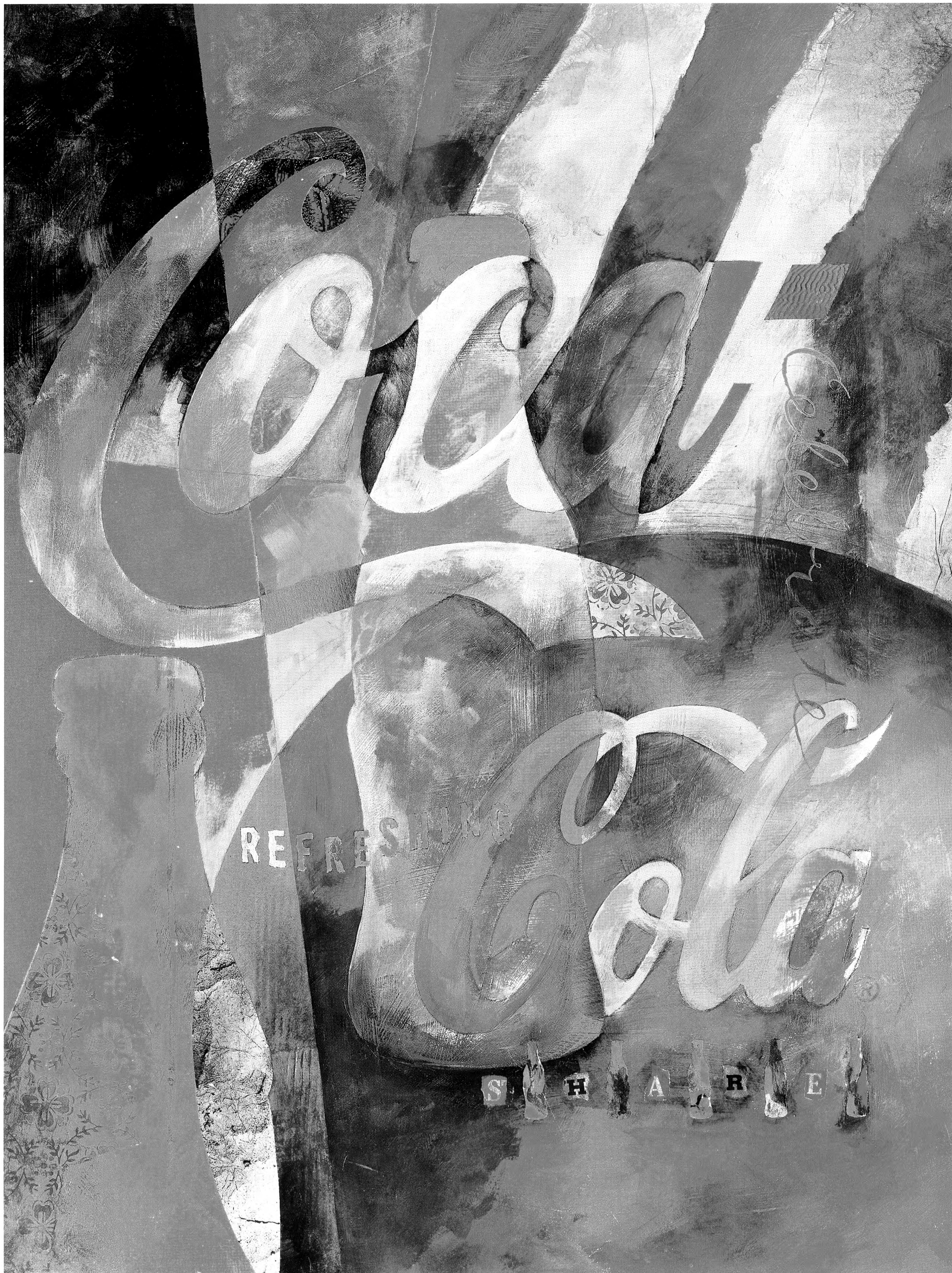


JULY/AUGUST 2005

Zoogoer

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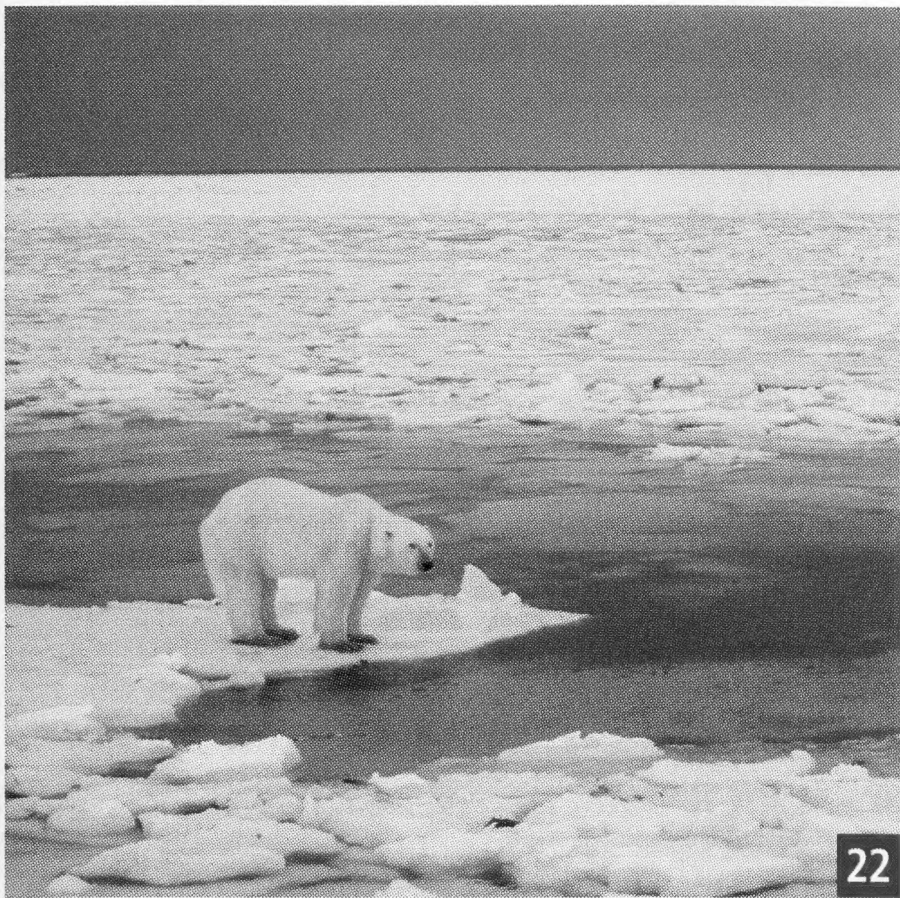
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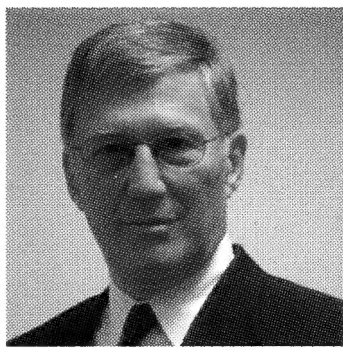
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FONZForum

Friends of the National Zoo wholeheartedly and enthusiastically welcomes the National Zoo's commitment to building a new Zoo habitat for Asian elephants, as described on the facing page by Interim Zoo Director David Evans. FONZ is dedicated to supporting the Zoo's efforts and we look forward to helping the Zoo create a future for Asian elephants here.

The National Zoo staff is developing very exciting plans for the new elephant facility. This facility, I'm sure you'll be happy to hear, will let us keep Kandula here as he grows into a powerful adult male—at 3½ years old he already weighs 3,100 pounds—and will enable the Zoo's female elephants to produce more babies in the years ahead. Moreover, staff are working to design the new habitat to meet all the needs of elephants, ensuring that these intelligent social animals live happy and healthy lives while contributing to the survival of their species, and inspiring members of our species to contribute as well. As these plans are finalized, FONZ members will be the first to hear the details as we ask you to support your Zoo.

But building a new Asian elephant exhibit at the Zoo is just the most visible component of an expansive—and expanding—program to celebrate, study, and protect these majestic endangered creatures in our Zoo and in the wild. With support from FONZ, our scientists are working with their colleagues at zoos throughout North America to improve the health and breeding success of elephants in zoos. Without this work, elephants could well become extinct in zoos and we would lose this important insurance policy against their becoming extinct in the wild. FONZ is also helping to support studies of Asian elephants in the wild, tracking their movements, mapping their habitats, and finding ways to reduce conflicts between elephants and the people who live among them.

We are also in the preliminary stages of planning a major new education initiative around elephants, modeled on the success of our award-winning Conservation Central Web-based education program. Conservation Central lets classrooms and families explore the complex issues surrounding the conservation of giant pandas and other endangered species that live in temperate-forest habitats. The world faces unprecedented pressures—on people and on wildlife and wild lands. The problems and opportunities these pressures create are mainly biological, making biological education essential. Harnessing the power of elephants to inspire children and adults alike, and using innovative distance-learning technology, our program will teach people around the world about wildlife, the natural world, and our place in the natural world.

As David Evans points out, building an elephant habitat, developing a new education program, and continuing and expanding elephant research and conservation will be neither easy nor inexpensive. Critics who believe that no zoo can be a good home for elephants will likely try to undermine our efforts. I believe it would be tragic if our children and grandchildren lost the chance ever to see an elephant, to marvel at its vastness and gaze spellbound at its amazing combination of strength, dignity, and grace. But I am confident that FONZ members and many other people in our community will generously support our efforts to keep elephants at the National Zoo and help them survive in the wild, knowing that children will be grateful for our success long into the future.

I will continue to share our plans and progress with you in the months ahead. In the meantime, please do not hesitate to email me (at jschroeder@fonz.org) your thoughts and ideas about elephants and any of our other programs, and help us make your Zoo the best in the world for animals and the people who love them.

Sincerely,

James M. Schroeder

James M. Schroeder
Executive Director



is a nonprofit organization dedicated to supporting the conservation, education, and research efforts of the Smithsonian's National Zoo. Formed in 1958, FONZ was one of the first conservation organizations in the nation's capital. Friends of the National Zoo is dedicated to supporting the National Zoo in a joint mission to study, celebrate, and protect the diversity of animals and their habitats.

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Membership in FONZ offers many benefits: programs, publications, discounts on shopping and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537, call 202.633.3034, or go to www.fonz.org.

Membership categories and annual tax-deductible dues are:

Family (includes children 3-16 years)	\$50
Double	\$45
Individual	\$40
Senior Citizen Individual	\$30
Contributing	\$75
Sustaining	\$150
Patron	\$250
Sponsor	\$500
Benefactor	\$1000
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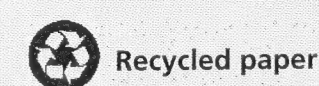
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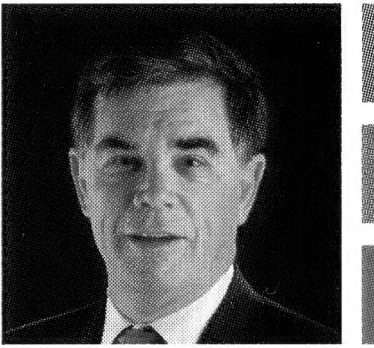
Cover photo: A polar bear (*Ursus maritimus*) rests on the ice near Churchill, Canada.

Photo by Don Getty/www.dongettyphoto.com.



The Smithsonian's National Zoo is accredited by the American Zoo and Aquarium Association.

Letter from David L. Evans



Elephants in Our Future

Many of you are aware of the current controversy clouding the future of elephants in zoos. Critics charge that elephants don't belong in zoos and are demanding they be removed from our collections. The National Zoo's very first animals were the Asian elephants, Dunk and Gold Dust, who arrived in Rock Creek Park even before bison made their famous walk up Connecticut Avenue from the Smithsonian Castle. Ever since, elephants have lived at the Zoo, amazing and delighting millions of people for more than a century.

Yet, one can legitimately ask if elephants, with all of their complex physical, social, and psychological requirements, can truly be happy and healthy in a zoo. All of us at the National Zoo agreed that if we could not say "yes," we would reluctantly have to do without elephants. Fortunately, that is not the case. Our scientists, animal care staff, and veterinarians know how to create an environment that meets elephants' needs for exercise, shelter, companions, and interesting activity—an environment in which females raise their young and all enjoy good health and long life. Our specialists in animal husbandry, behavior, ecology, nutrition, genetics, veterinary medicine, reproductive sciences, pathology, and conservation biology work together to discover and apply new knowledge to ensure that all of our animals thrive in the Zoo and their species survive in the wild. Our scientists were the first to identify the often deadly herpes virus that attacks elephants, and were part of an international team that developed an artificial-insemination technique for elephants. Our reproduction laboratory currently monitors the reproductive hormones of more than 200 elephants in the United States to identify the most viable females for breeding.

We have learned quite a lot since the time of Dunk and Gold Dust and we know that building a great new place for our Asian elephants—eventually a group of females, males, and young—is essential. We cannot leave our female elephants in their current outdated accommodations, and keeping our growing young male, Kandula, there will soon be impossible. The sprawling new elephant habitat and house we envision will feature spacious, enriching indoor and outdoor areas, as well as places where visitors can learn about elephants, about what our scientists are doing to save these marvelous animals in the wild, and about what all of us can do to help. This will be neither easy nor inexpensive, but with a generous commitment from Congress and the support of private donors and the public, we can make this happen.

But the real question is not if we can do it, but should we?

Only 35,000 to 50,000 Asian elephants survive in the wild. The threats they face are familiar. Poaching for ivory tusks and other human-caused deaths are persistent problems, but the most severe threat is loss of habitat due to logging and conversion for agriculture. Asian elephants need forest with plenty of forage and water—habitat that is also ideal for human use. The effects of habitat loss are made worse by the division of what remains into small "islands" separated from each other by terrain impassible to elephants. Inbreeding in such isolated populations can lead to reduced fertility, increased risk of disease, and, ultimately, extinction. Moreover,

small, hemmed-in populations are always at risk from natural catastrophes such as flood, drought, or fire, and conflicts such as war and other social upheavals. Our scientists are mapping remaining habitat in Asia to identify the most promising areas for conservation action, as well as studying the impact of the recent tsunami on elephants in Sri Lanka—a perfect example of a natural catastrophe that could have decimated an elephant population.

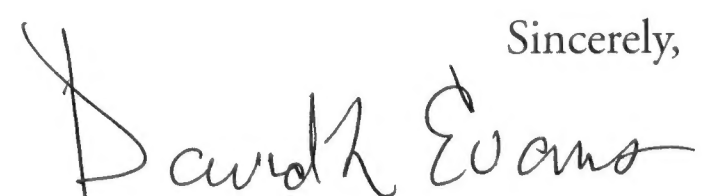
What makes the Asian elephant's situation in the wild all the more dire is that no self-sustaining zoo population exists as insurance against the species' extinction—something our scientists and their colleagues are making every effort to change. Their success in bringing Kandula into the world is a testament to the value of their work.

But science alone cannot ensure a future for elephants. People everywhere must be committed to making room for these magnificent animals in our crowded world. The National Zoo's purpose is to bring the natural world to our mostly urban American visitors: to inspire, to inform, and to involve them with elephants and other wild animals that live far from our cities but may be essential to our own survival.

Few creatures are so awesome and inspiring as elephants. No film or image can convey the extraordinary reality of a living elephant, but very few Americans will ever see one in the wild. Because we do have the space and the expertise, it is the obligation of the nation's zoo to let people see an elephant as the "real thing," and thus be moved to a commitment to saving them.

We all have memories of first making contact with elephants. For some it is as a child gripping a parent's hand on first sight of such an immense creature. For me, it was a look into an elephant's eye. As a college student in Philadelphia, I would visit the zoo to take photographs. Very few of those pictures remain, but I have kept one—a black-and-white side view of an elephant's face. I am still drawn to the look in her eye. In Kenya last summer, I photographed elephants again. Looking through those pictures, I found one of an elephant with the same look as the one from years ago. How can looking past the wrinkles into the soul of an animal to see its strength and dignity not move you?

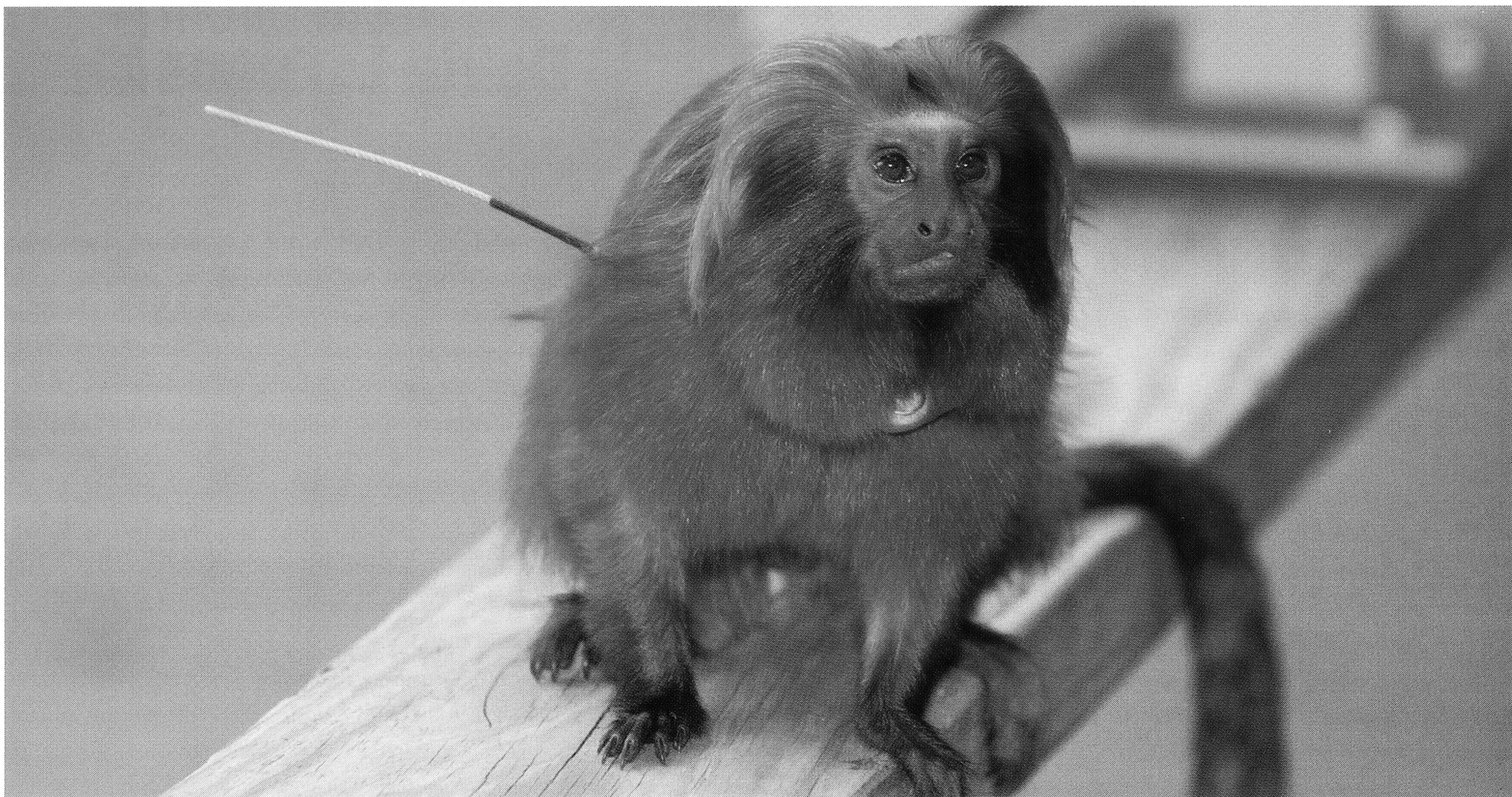
We at the National Zoo are determined to preserve people's ability to have such an experience, now and long into the future, in zoos and in the faraway places where elephants still roam. I hope you will join in supporting our efforts to keep elephants at the National Zoo.

Sincerely,


David L. Evans

Under Secretary for Science, Smithsonian Institution,
and Interim Director of the Smithsonian's National Zoological Park

Notes&News



On your next visit, keep an eye out for free-ranging golden lion tamarins like this one. The little monkeys like to explore the trees and walkways near their nest box.

Animal News

If you see a streak of orange moving through the trees at the Smithsonian's National Zoo this summer, you've spotted one of two free-ranging **golden lion tamarins** (*Leontopithecus rosalia*)—small, Brazilian monkeys—exploring the outdoors. This year's charismatic tamarin pair nests in a modified cooler affixed to a tree in Beaver Valley. Eduardo, the male, has nested alfresco before, but it's the first time for his new partner, Laranja, a female from the Philadelphia Zoo. They spend the day scampering along ropes and branches, sleeping, and searching for hidden food as part of an enrichment activity that simulates their foraging behavior in the wild. They will remain outside until October, when the weather gets chilly and they return to their exhibit inside the Small Mammal House.

This is the 20th summer the Zoo has allowed golden lion tamarins to range freely in the park and studied their outdoor behavior. The little monkeys usually stay within a few hundred feet of their nest box, but also wear radiocollars so Zoo staff can keep track of their location. Volunteer FONZ behavior watchers tail the tamarins for 12 hours each day and record their every move. You can read some of the watchers' observations at www.fonz.org/monkeymessages.htm.

For the Zoo's female **cheetahs** (*Acinonyx jubatus*), the race to motherhood is on. First-time mother Tumai gave birth to two male and two female cubs in November; hers was the first cheetah litter ever born at the National Zoo. In April, Zazi, also a first-time mother, upped the ante by giving birth to five healthy cubs—two males and three females. Zazi was bred with male Ume under the auspices of the American Zoo

and Aquarium Association's Species Survival Plan for cheetahs, which manages genetic diversity in endangered species. For the latest updates on the Zoo's nine cubs, to find out when they'll be on exhibit, or to watch them on the Cheetah Cams, go to www.fonz.org/africansavanna.htm.

She's cuddly now, but just wait 'til she grows up! A **prehensile-tailed porcupine** (*Coendou prehensilis*), arguably the cutest baby at the Zoo, was born at the Small Mammal House in April. At birth, her quills were only ¼ inch long and were wet and soft, but they hardened a few hours later and will lengthen as she matures. Prehensile-tailed porcupines are nocturnal rodents native to Latin American forests. When threatened, they roll into a ball to protect their soft underbellies and flex their muscles to make their sharp quills stand on end.



Prehensile-tailed porcupine.

Which animal has the face of an agouti, the legs of a tiny deer, and weighs less than a fat house cat? This strange amalgam of animal parts belongs to none other than the **greater Malay mouse deer** (*Tragulus napu*), one of the smallest even-toed ungulates in the world. Check out the Zoo's two new females, which came from the Bronx Zoo in April, at the Small Mammal House. They are native to the Malayan peninsula and nearby islands, but are seldom seen in the wild because they are nocturnal and quite shy. You might catch them stamping the ground with their hind feet if they sense danger. Mouse deer, also called chevrotains, are not closely related to rodents such as mice or agoutis, but they do belong to the same order as deer, pronghorns, giraffes, and cattle.

Events

For more information on celebrations at the Zoo, or to purchase tickets to Brew at the Zoo, please visit www.fonz.org/celebrations.htm.

Sunset Serenades

Thursdays, June 30 to August 4—6:30 to 8 p.m.

Enjoy six evenings of free musical entertainment on the lawn of the Zoo's Lion/Tiger Hill. With a range of musical styles including oldies, jazz, reggae, pop/rock, blues, and classical, these concerts are sure to please all ages.

Brew at the Zoo

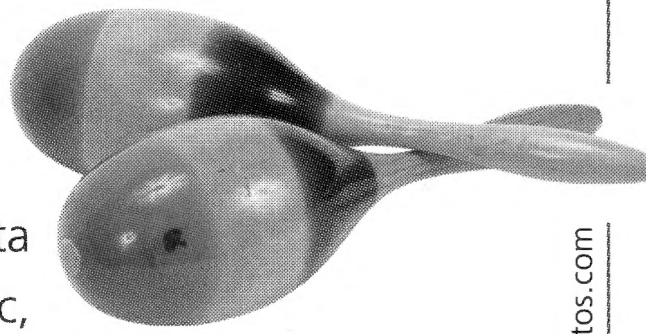
August 25—6 to 9 p.m.

Sample handcrafted beer from local and European breweries, groove to live music, and enjoy hors d'oeuvres while visiting the Zoo's animals. Tickets are \$25 for FONZ members and \$35 for nonmembers. Price includes a commemorative glass.

Fiesta Musical

September 18—11 a.m. to 5 p.m.

FONZ celebrates Hispanic Heritage Month with a free annual Fiesta at the National Zoo. With animal demonstrations, Latino music, costumed dancers, salsa and merengue lessons, traditional crafts, and Latin American foods, the event offers something for everyone. Animal programs are presented in Spanish and English.



www.photos.com

Lectures

For more information on Zoo lectures and to RSVP, please visit www.fonz.org/lectures.htm.

To See Every Bird on Earth: A Father, a Son, and a Lifelong Obsession

June 14—Book signing at 7 p.m., lecture at 7:30 p.m.

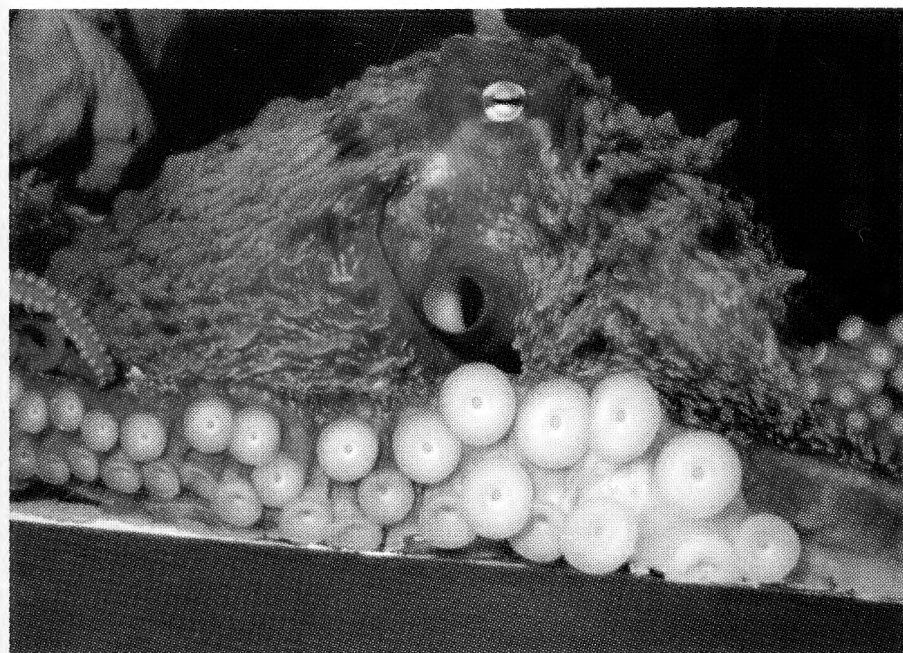
Author Dan Koeppel will sign and talk about his new book, which artfully weaves biography, autobiography, and the history of birding in America.

The Lady and the Panda

July 20—Book signing at 7 p.m., lecture at 7:30 p.m.

Writer Vicki Constantine Croke will sign and talk about her new book, which relates the exploits of Ruth Harkness, a socialite who brought the first giant panda to the United States.

Volunteer Corner



Jessie Cohen/NZP

A giant Pacific octopus at the Invertebrate Exhibit.

Mike Bevel is a volunteer interpreter at the Invertebrate Exhibit. Here, he describes how visiting Zoo animals helps people reflect on their own lives.

"I bet it's nice in there," said the older woman in the tan coat and Sunday shoes. We stood in front of the giant octopus tank. "The water looks calm. Peaceful."

"Most visitors worry that she doesn't have enough room," I said. "When they hear 'giant Pacific octopus,' they expect a larger tank."

"You know, I lived in a studio for years after my kids moved away. I liked it just fine. Not as many things to bump into. I had good windows in that apartment." She squinted into the tank. "What are those things on the wall behind her?"

"Her eggs."

"A mama all by yourself, are you? I remember that." She rested her hand against the cool aquarium glass. The octopus reached out an arm. Maybe they were contemplating each other. "Does she see me? Does she know I'm here?"

"Probably as well as you can see her."

"If I could hold my breath long enough, I'd like to go in there. Help her with the eggs. So many of them. They look like strings of pearls."

"She'll do all the caretaking on her own. They're not very social animals."

"Probably the last thing she needs is an old busybody in there, telling her how to raise her babies. I hated that." She

smoothed down her coat, moved her purse to her other arm. She looked at me in all seriousness: "I'm humbled every time I come here to this zoo. My whole life, I paid this much attention to the life around me—" she held her thumb and index finger in front of her eye. "Then I see this octopus, or those ants you have in the back, or the otters. I really love those otters. And they're each doing things I've done, right? Raising a family, working at what seem like endless tasks, playing. There's a crow comes to my backyard that I think is mourning the loss of his wife. I never knew how much I'd understand about being a human from watching an octopus."

As a volunteer, I often spend so much of my time answering questions about the animals—what they eat, where they live, what they do, why they do it—that I forget they have much to tell me about my own life. We stood together a few more minutes, the woman and I, watching the octopus.

If you'd like to volunteer at the National Zoo, please visit www.fonz.org/volunteer.htm or call 202.633.3025.



The grandson of a Dani tribe's chief savors a mouthful of toasted stink bugs (family Pentatomidae) in Irian Jaya, Indonesia. In some countries, eating insects is a cultural tradition and a nutritional necessity.



BY ALISON FROMME
PHOTOGRAPHS BY PETER MENZEL

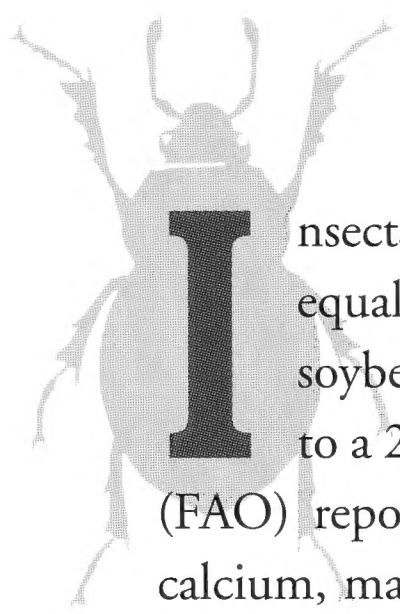
EDIBLE Insects

Can eating insects help fight hunger and promote biodiversity?

Yes, but only if Westerners can get over “the yuck factor,” explains Gene DeFoliart, professor emeritus at the University of Wisconsin, Madison, and promoter of insects as food. Although people worldwide have been enjoying edible insects since ancient times, their value—in terms of both nutrition and conservation—is often overlooked by the modern Western world. And because Western tastes are so globally influential, people elsewhere may begin to shun insects as an important food source.

An estimated 2,000 insect species are consumed around the

world, and people do not just eat insects, they relish them as delicacies. In Africa, caterpillars and winged termites are fried and eaten as roadside snacks (after wings, legs, and bristles are removed, of course), and often considered tastier than meat. Grasshoppers and bee larvae seasoned with soy sauce are favorites in Japan, where pricey canned insects are also available. Papua New Guinea is known for its nutty-flavored sago grubs (*Rhynchophorus ferrugineus papuanus* or *R. bilineatus*), beetle larvae that inhabit dead sago palm trees and are honored at annual festivals.



Insects often contain more protein, fat, and carbohydrates than equal amounts of beef or fish, and a higher energy value than soybeans, maize, beef, fish, lentils, or other beans. According to a 2004 United Nations Food and Agriculture Organization (FAO) report, caterpillars of many species are rich in potassium, calcium, magnesium, zinc, and iron, as well as B-vitamins. In some African regions, children fight malnutrition by eating flour made out of dried caterpillars. Pregnant and nursing women as well as anemic people also eat caterpillar species high in protein, calcium, and iron.

Yet nutritionally important traditional foods such as insects have been ignored by agricultural aid efforts in Africa, wrote Jennifer Clover, a researcher at the Institute for Security Studies in South Africa, in 2003. Dramatic increases in farming yields achieved through breeding programs during the Green Revolution between 1944 and 1975 helped to fill bellies in developing countries, but these

crop plants alone did not provide a full complement of nutrients. Additionally, billions of dollars are spent worldwide to protect nutritionally inferior crops with chemicals that kill perfectly edible insect "pests," according to Julieta Ramos-Elorduy, a researcher at the Universidad Nacional Autónoma de México in Mexico City, pointing out one global effect of the modern Western bias against entomophagy, the eating of insects.

Ramos-Elorduy suggests there are no fewer than 34 reasons to explore insects as a food source, including their impressive nutritive value, easy breeding in captivity, and high biomass. She proposes enriching consumer foods with insect flour in order to make them more nutritious. "Finding an economic and nutritional use for insect species provides an important means to avoid species extinction," Ramos-Elorduy says.

In some cultures, edible insects are already a hot commodity. In northeastern India, for example, edible silkworm pupae (*Bombyx mori*) are prized more than the silk they produce, and some Mexican restaurants charge a hefty \$25 for a plate of butterfly larvae. Chinese consumers spend about \$100 million per year on edible ants alone.

Linking Caterpillars and Conservation

The availability of high-quality edible insects is closely tied to healthy, intact forests. Without trees and foliage to munch, insect populations plummet, so triggering interest in preserving insects as food sources might be one way to protect swaths of forests and the biodiversity within them.

In many regions where forest degradation is acute, residents are too preoccupied with day-to-day survival to consider the luxury of protecting the environment. But wise management of natural resources could achieve two vital goals: raising living standards and conserving biodiversity.

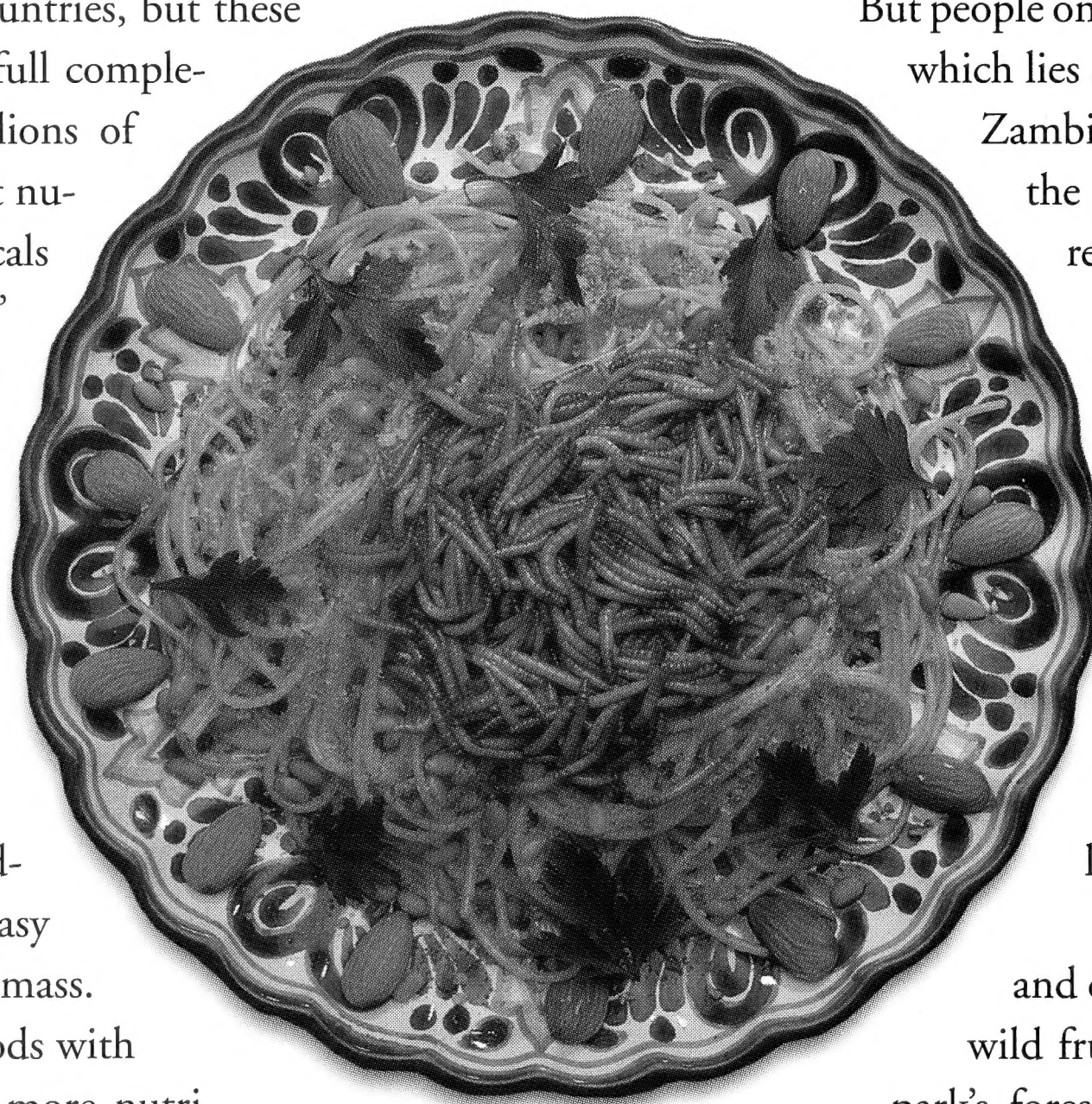
In Malawi, a small country tucked between Zambia, Tanzania, and Mozambique, habitat conservation might seem at odds with the needs of citizens, the majority of whom subsist on less than \$170 a year and will not live to see their 40th birthdays. Malawi's hilly woodland terrain provides habitat for elephants, antelopes, and other wildlife, as well as crucial resources, such as food and firewood, for human residents. A fifth of the country's land is set aside as parks and reserves, which helps protect precious biodiversity from the demands of a growing population.

But people on the outskirts of Kasungu National Park, which lies at the western edge of Malawi along the Zambian border, have trouble identifying how the park benefits their lives, although some residents are seasonally employed there. No one has lived on the park's lands since it was established in 1930, under British rule. When the park boundaries were drawn, people were forced to leave the land and their woodland lifestyle behind. Current entrance fees are unaffordable for the residents and money earned from tourists goes straight to the government, not the local people.

Some elders recall hunting antelope and collecting firewood, mushrooms, honey, wild fruit, roots, and edible caterpillars in the park's forest. Without access to the forest today, most people subsist on small plots of land where they farm maize and sometimes beans, groundnuts, and cassava. Some encroach onto park land to collect resources that they believe were theirs in the first place, but park officials view this behavior as a threat to the country's biodiversity.

Remarkably, caterpillars and some carefully crafted policies might be inching residents and park managers toward a more mutually beneficial relationship. Before the park's creation, everyone in the region collected, processed, and roasted two main caterpillar species—the orange-spiked, black-bodied *Gonimbrasia belina*, and the fleshy green *Gynanisa maia*, both known locally as Matondo—and served them fried or in stews.

Outside the current park boundaries, there are no caterpillars to collect because their preferred host tree (*Julbernardia paniculata*, a species important in an African woodland ecosystem called



A Mexico City entomologist published her recipe for this mealworm spaghetti in a cookbook of insect cuisine.



Asmat villagers in Irian Jaya harvest the pulp of sago trees to make an edible starch. As they work, they collect grubs from the palms, such as the Capricorn beetle larvae (*Rhynchophorus ferrugineus*) this child is eating, and cook them for snacks or meals.

Miombo) has been chopped down by villagers who need firewood for cooking and heating.

In the early 1990s, Malawi's Department of National Parks recognized that caterpillars inside the park could help give people a reason to value the park and its protection. The department began allowing locals to harvest caterpillars, which they either eat or process and sell for additional income. The program has since expanded into other protected areas in Malawi where caterpillars are abundant.

The endeavor is not without difficulties, however, according to former Senior Parks and Wildlife Officer Simon Munthali, who helped initiate the program as one of the park's management strategies. Now head of the African Wildlife Foundation's (AWF) Conservation Service Center, Munthali says that caterpillar populations fluctuate extensively from year to year, "making it quite difficult to predict yields and set sustainable harvest quotas." Lack of funds in recent years has also jeopardized the success of the program. Munthali suggests creating local institutions that could effectively manage the program.

Nonetheless, Munthali sees promise in caterpillar harvesting within the park. "The potential to benefit local communities is higher than in subsistence agriculture, which is being further constrained by frequent drought in Malawi," he says. Additionally, caterpillar season begins just as other sources of food, such as maize, dwindle.

Despite its imperfections, Malawi's program represents an innovative move toward protecting biodiversity while providing people with vital income and food. In the future, Munthali plans to begin a

new caterpillar harvesting project in Mozambique's Banhine National Park, as part of AWF's efforts to support Mozambique's government in rehabilitating the isolated park.

"There is no formal economy for the people living in the area, agriculture is unsustainable, there are no employment opportunities, no markets of any kind. Poverty is rife," Munthali says. Caterpillars just might provide much-needed revenue, and in turn bring higher living standards, better nutrition, and a tangible reason for community members to protect the local biodiversity.

From the Forest to the Feast

In parts of sub-Saharan Africa, edible caterpillars can be quite abundant—averaging as many as seven pounds of processed insects per tree. The sight of caterpillar frass on the ground and chomped leaves on trees are clues commonly used to track the insects. In the Democratic Republic of the Congo, people call out to Minsangula caterpillars (family Saturniidae), saying "hey, hey" until the caterpillars respond to the noise by jerking from side to side, revealing themselves to their hunters.

Women and children are the primary caterpillar collectors. When some caterpillar species mature, they form large processions and descend down the tree trunks, so harvesters simply pluck them off the trees. Caterpillars are so important to the local diet and income in the Central African Republic that women move to the best harvesting areas with their children and set up huts for two months each year.



In Australia, witchetty grubs (above left) are a traditional food for Aboriginal people, who dig for them among the roots of witchetty bushes (above right).

Some people even “farm” their own caterpillars. Paul Latham, a retired Salvation Army agriculturist who has been interested in edible insects for more than 20 years, met one man from the Democratic Republic of the Congo who has cultivated a backyard population of the black, red, and yellow Ngala caterpillar (*Cirina forda*) from caterpillars he purchased in the village market. Villagers there plant *Ricinodendron heudeloti* trees to attract Mvinsu moths (*Imbrasia epimethea*) to lay their eggs for easier harvesting later on.

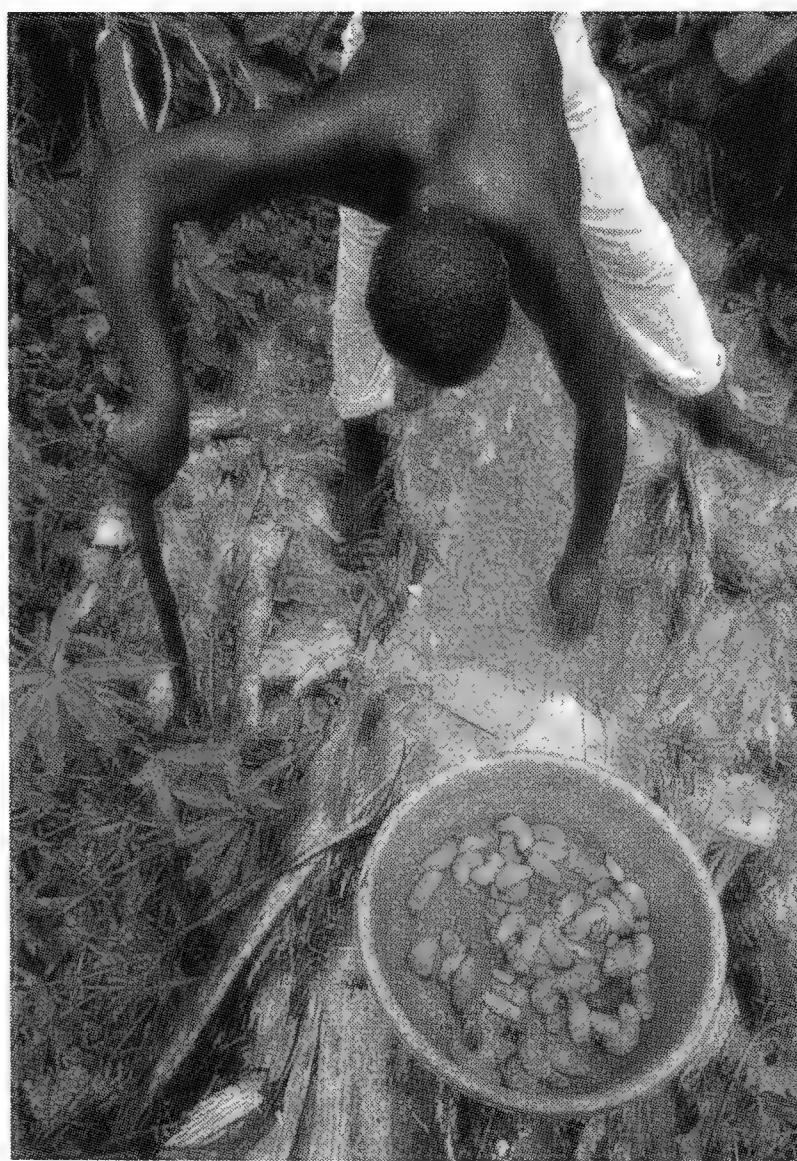
Traditionally, some cultures have observed strict societal rules surrounding caterpillar gathering to make sure populations survive from year to year. A Bas Congo custom directed people to harvest only one of two annual caterpillar generations, leaving the second “for the birds,” according to Latham, and caterpillars on high branches were generally left alone. But some people cut whole branches or trees down to collect heaps of caterpillars at once. This practice could ultimately lead to the decimation of the forest and may become a bigger threat if human populations and poverty increase.

In the Zambian district of Mpika, where the Bisa people have collected Chipumi (*Gynanisa maja*), Mumpa (*Gonimbrasia zambesina*), and other caterpillar species for centuries, the Kopa region’s senior chief ensures that caterpillar harvesters follow traditional rules. In September, village scouts notify the chief when eggs are found. The chief ceremonially thanks the Bisa ancestors for the caterpillars by placing a white cloth over a shrine. He rips the cloth, leaving a por-

tion with the shrine and tearing the rest into small strips that he distributes to his grandsons, who use the cloth to mark the trees with the highest egg densities. Later, when the caterpillars reach their first developmental stage (known as the first instar), some are brought to the chief, whose senior wife offers them to the shrine, asking the ancestors to protect the people during the harvest. When the caterpillars mature, several are again presented to the chief and his wife, who makes a second offering. At this point, the chief’s top officials establish the price of the caterpillars (\$4.29 per gallon in 2000) and the length of the harvesting season, considering current densities and the previous year’s demand in the decision.

Harvesting immature caterpillars or allowing the harvest season to last indefinitely could hamper the success of the next generation—which this traditional system prevents.

Not all communities follow such rigid harvesting procedures, but caterpillar processing is relatively consistent across cultures. The first step for species such as Ngala and Mvinsu, which feed on bitter or toxic plants, requires removing the gut, either by using a stick to



A Ugandan man collects beetle larvae, then cooks them with salt, curry, and onions.

turn the caterpillar’s body inside-out, or puncturing then squeezing its body. Particularly hairy or spiny species are boiled in salted water to remove these undesirable parts before the caterpillars are dried in the sun and smoked on a grate over a fire. For a snack, the caterpillars are sometimes fried in palm oil and seasoned with salt. They’re also commonly eaten in sauces with meat, fish, or vegetables such as mushrooms or manioc.



Water beetles are marinated in ginger and soy sauce and garnished with carrots in Guangzhou Province, China.

All this work pays off in terms of nutritional value and actual income, according to the 2004 FAO report. In some sub-Saharan African countries, up to 30 percent of all the protein in a person's diet comes from insects. Because caterpillars are a favorite food, selling them there can also be quite lucrative. Throughout the region, collectors can earn an average of about \$0.80 per pound of dried caterpillars, while retailers earn about twice that. Wholesale business is most profitable, netting almost \$600 per year on average—more than 3.5 times the average Malawian salary.

The Forgotten Crop

"Insects are really the forgotten food crop, particularly because of the Western world's dominance on judging foods," according to FAO researcher Paul Vantomme, who echoes DeFoliart's sentiments. The FAO reported that edible insects contribute significantly to the livelihoods of the poorest and most disadvantaged people in central Africa, although the organization has not historically kept data on insects as crops.

The origins of cultural bias against entomophagy in the modern Western world are unclear, according to Ronald Taylor, author of *Butterflies in My Stomach: Insects in Human Nutrition*. In the Bible, Moses says that eating locusts, crickets, and grasshoppers is acceptable under Jewish law. King Solomon is rumored to have fed locusts to his wives. In the New Testament, John is portrayed eating honey and locusts. Roman and Greek scholars such as Pliny the Elder, Herodotus, and Diodorus also recorded instances of insect-eating. According to Taylor, modern Westerners' fear of entomophagy contradicts the popularity of honey, which he describes as "bee vomit."

But insect appeal is growing among all kinds of people, worldwide. Wittchety grubs—moth and beetle larvae that can be up to five inches long and taste like nuts when cooked—were once eaten

only by Australian Aborigines, but are now a favorite among tourists. Wasps, bamboo caterpillars, crickets, and locusts are enjoyed in Thailand's rural regions and in upscale restaurants. Leafcutter ants are a delicacy eaten by the upper class in Colombia, where they are sometimes compared to French truffles or Russian caviar in cachet. Specialty food shops in Europe have started to sell insects imported from Africa. Even a U.S. company, Hotlix, sells various lollipops with embedded insects, chocolate-covered cockroaches, grubs, slugs, and grasshoppers, and mealworms in barbeque, cheddar cheese, and Mexican flavors.

This trend toward reducing the bias against insects as food is promising, according to DeFoliart, who promotes adding nutritional value to staple diets and maximizing ecological benefits with edible insects. He contends that modernization has led indigenous populations around the world away from traditional food sources including insects, without providing nutritionally equivalent substitutes.

Insects link biodiversity conservation and human nutrition in a way that many other food sources do not. Edible insects are generally abundant, nutrient-dense, marketable, and economically valuable. For people who have traditionally relied on insects for food, sustainable use of insect resources could lower nutritional deficiencies and raise living standards. Safeguarding forest habitats for edible insects also prevents erosion, preserves water resources, and protects countless other forest species.

According to DeFoliart, increasing food and income for poor families can decrease the pressure for land clearing, intensive monoculture agriculture, and pesticides—and therefore preserve biodiversity. Z

—Alison Fromme is a freelance science writer living in Berkeley, California. Despite her adventurous eating habits, she has not had the opportunity to try entomophagy.



CAPITAL Coyotes

BY HOWARD YOUTH

On a cool late March morning in Rock Creek Park, I tramp along a slope thick with oak leaf litter, following khaki-clad Ken Ferebee over spring beauty wildflowers and through bud-swollen spicebush branches. The park preserves 1,755 acres, mostly in Northwest Washington, D.C.; as its natural resources management specialist, Ferebee keeps an eye on plants, the growing deer herd that damages them, box turtles, and other creatures. He's been on the job here since 1991, but just last year a new animal crossed his radar—one that intrigues not only him and me, but the entire D.C. metropolitan area. The coyote's come to town.



Once an emblem of the Wild West, coyotes are rapidly expanding their range eastward. Within the last few years, some settled in Washington, D.C., prompting scientists and conservationists to wonder how coyotes might change the area's ecology and locals to fear for the safety of their pets.



Ken Ferebee/NPS

In November 2004, a camera trap captured these two coyotes investigating the carcass of a deer in Rock Creek Park.

Ferebee takes me to the top of the wooded ridge and points to four gnarled fallen trees that lie parallel to each other like herring bones. At one end of each bulges an orange mound of soil left around the trees' now-rotted roots. "I've been finding dens around these root balls, in secluded, protected types of situations," says Ferebee. Stepping over the log closest to us, I easily see what Ferebee promised he'd show me—a two-foot-wide hole dug under the log, between the root ball and the base of the trunk. "This looked pretty active when there was snow on the ground," Ferebee tells me, describing how he found what were most likely coyote (*Canis latrans*) tracks in the snow and had noticed freshly dug soil all around the den site two months before. The tunnel jogs left and out of sight soon after plunging beneath the ground. Ferebee then shows me a hole near another fallen tree 15 feet away, which he believes is an exit.

"I've not seen this one before," he says, kneeling down for a better look at a smaller hole dug under another nearby log. "This could be a fox den or a [coyote's] work in progress." We talk about the park's deer concerns—the 36 reported deer-car collisions in 2004 and the large herbivores' impact on herbaceous plants—and the coyote, a predator that has been sighted in or near the park almost 30 times in less than a year and one that could also change this urban forest.

Will coyotes solve the deer problem? How will they affect local wildlife populations? Will they kill many area pets? These and many other questions about the animals' biology and adaptation to the eastern United States remain unanswered. But now that coyotes are here, Ferebee and others are on the lookout and learning more every day.

Hundreds of thousands of coyotes are trapped, shot, or poisoned each year, apparently with no overall effect on their population.

March of the Prairie Wolf

"Coyote. Prairie Wolf. Common on the Great Plains, burrowing in the ground. A vagabond, dog-like animal, 'half bold and half timid, yet lazy all through.'"

In 1929, David Starr Jordan thumb-nailed the coyote this way in the 13th edition of his *Manual of the Vertebrate Animals of the Northeastern United States*. At the time, coyote sightings stretched as far east as Illinois. Today, the "vagabond" lives

throughout the United States except in Hawaii, through much of Canada, and down to Panama. Following the coyote's incredible expansion, which is one of the most rapid of any carnivore, it certainly seems anything but lazy.

In fact, if you want to anthropomorphize the coyote, you might call it an over-achiever. "The successful colonization by the coyote of most of North America...over the past 100 years is unparalleled

by any other species of terrestrial mammal in recent history," writes Canadian Wildlife Service biologist Gerry Parker in his book *Eastern Coyote: The Story of Its Success*. Two ingredients made the coyote's spread eastward a success over the last century: The hacking down of eastern woodlands left more open areas and forest edge for coyote habitat, and the virtual annihilation of gray wolves (*Canis lupus*) in the East and Northeast and red wolves (*Canis rufus*) in the Southeast eliminated two of the coyote's most formidable competitors.

Washington, D.C., received its first coyote reports very late in the game. In May 2004, a motorist reported seeing one on the side of a road in Rock Creek Park. Coyotes had already reached northern Virginia, Maryland, and Delaware—among the last places to report them—in the 1980s and 1990s. But that's not to say that coyotes weren't around before then. Hunters know that coyotes are not easy to pin down. Nighttime yips, barks, and howls often confirm their presence, as do findings of coyotes hit by cars. But no one can say for sure when the first coyote paws crossed state lines.

In the past, some coyotes were kept as pets or used as quarry to train hunting dogs, which may explain the origin of a solitary coyote shot in Cecil County, Maryland, in 1961. In the 1969 Department of the Interior report *Mammals of Maryland*, biologist John L. Paradiso wrote: "The question naturally arises as to how a coyote reached this eastern locality. It is, of course, impossible to say definitely. The animal probably escaped from captivity. Or it may represent an extreme eastern extension of the geographic range of coyotes."

These days, the coyote stands alongside the eastern cottontail (*Sylvilagus floridanus*), white-tailed deer (*Odocoileus virginianus*), and raccoon (*Procyon lotor*) as a familiar mammal of eastern forests and fields. As coyote numbers grow, more and more people are seeing them during nighttime drives, or even in their backyards. Cameras don't lie, and biologists' motion-sensitive cameras help mark the coyote's advance. When Zoo Conservation and Research Center (CRC) veterinary technician Lisa Ware checked out the digital camera trap she'd set in hopes of recording a bobcat she thought was denning on the facility's property, she found something quite different. "Catching a coyote on the camera trap at its present location was a surprise. I have the camera set along a frequently traveled gravel road that services one of the hoofstock barns. This road is pretty much in the heart of the campus." Over the past few years, coyotes have turned up infrequently at CRC. The bobcat vanished from the area after the coyote photos were taken. Ware says, "My suspicion—hope—is that the cat detected the increased presence of the coyote and has shifted her denning site." In other areas such as Florida and Maine, bobcats share common range with coyotes and researchers suspect that they coexist but avoid each other's core areas of activity.

Although they're around, you may be disappointed if you go out looking for coyotes. Rob Gibbs, a natural resources manager for the

Maryland-National Capital Park and Planning Commission, goes out from time to time and plays a tape of rabbit distress calls to attract Maryland's newest predator. "My calling technique must be okay because I'm calling in foxes like crazy, but no coyotes," he says. "Just knowing the persecution they've faced and knowing how they survived, obviously they learn quick and don't make the same mistake twice."

Among sheep raisers and other ranchers out West, coyotes are as reviled as cockroaches in a New York City apartment. "It may be spiritually rewarding to hear the chorus of coyotes at day's end," writes Parker in *Eastern Coyotes*, "but that twilight song may sound different to the farmer who lost a prize ewe to those same coyotes the previous evening."

This gives perspective to the ongoing campaign against western coyotes. Hundreds of thousands are trapped, shot, or poisoned each year, apparently with no overall effect on their population, although local declines have been noted. Some researchers found that high mortality actually increases coyote litter size.

On average, female coyotes bear four to six pups per litter, but can have as many as 19. Litter sizes may increase in a population pressured by hunting, trapping, or poisoning.



Bruce Coleman Inc./Larry Allan



On wide-open western rangelands, the coyote will continue to compete with livestock raisers for their animals—in essence, for our food. But that's not to say that the coyote is not foiled in some places. Some ranchers swear by trained guard dogs or burros that hang out with sheep flocks and drive off coyotes on sight. Others pay closer attention to their fence lines, repairing holes or installing electrified lines that repulse curious coyotes. In many parts of the East, livestock sleep in sheds or barns at night, a practice that greatly reduces chances of coyote attacks. At a local level, livestock attacks have yet to become commonplace. “We’ve had coyotes in the state now pushing 20 years,” says Steve Bittner, a game mammal section leader at the Maryland Department of Natural Resources (DNR). “There’s been some livestock killed. A little bit. Not a lot.” Each year out West, however, coyotes kill thousands of sheep, goats, chickens, turkeys, and some calves and hogs, too.

Keeping Coyotes Wild

On the suburban scene, one thing local residents need to learn is that coyotes may attack pets their size or smaller. “We have problems with dogs off leashes in the park,” says Ferebee. “There might be some incidents because of that. Coyotes will defend their dens and young.” In 2004, two mid-sized dogs were probably attacked by coyotes after their owners let them off their leashes despite the park’s leash rule.

Long unchallenged, except by occasional clashes with other cats or dogs, area house and feral cats may already be changing from predators to prey. “In this area, there are a lot of feral cats,” says Gibbs, “which tend to disappear when coyotes reach an area.”

“It’s possible—probably even likely—that posters you see on telephone poles for missing cats could be related,” adds Fairfax County wildlife biologist Earl Hodnett. Just ask Michael Soulé, professor emeritus of the environmental studies department at the University of California at Santa Cruz. He grew up in coyote country and has studied western coyotes for years. “The smart cats avoid coyotes by staying home, up on the rooftops or in the trees, and the other ones get eaten,” he says, adding that as a child he lost almost half of his cats to coyotes.

“Right now, not many people are seeing coyotes,” says Gibbs. “When they do, the coyotes are running away. We need to start educating people about the basic stuff: Keep the trash tightly closed.

Don’t put out any pet food. We need to keep them as wild as possible. As long as they are afraid of people, they’re not going to be a problem.” Hodnett, Ferebee, and many other wildlife officials echo Gibbs’ advice. Coyote attacks on people are rare, but where they have occurred, such as in the Phoenix, Arizona, area and in some western parks, the animals involved are usually accustomed to feeding on food or trash in backyards.

How will coyotes affect wildlife? In snowbound northeastern forests, coyotes can be major predators of white-tailed deer, dragging

down healthy adults in deep snow. But in general, coyotes feed mostly on whatever they come across while coursing through their habitat. With an abundance of fawns and roadkills, D.C.-area coyotes should be familiar with the taste of venison, but they are just as likely to focus their efforts on rodents, rabbits, berries, trash, pet food, and a variety of other foods. Will deer feature prominently on their menus? “I don’t know if they will make a serious difference around here,” says Gibbs, who spends much of his time grappling with ways to manage Montgomery County’s surging deer herd. “Coyote numbers are still low. It depends. I’m taking a wait-and-see attitude, but I have my fingers crossed.”

The coyote-deer association is much discussed and has even become the stuff of urban legend. “There’s a rumor out there the last year or so,” says Maryland DNR’s Bittner. “The rumor has it that auto insurance companies are in cahoots with state wildlife agencies to stock coyotes to eat deer.

This is supposed to bring down deer populations, which brings down deer collisions, which brings down insurance claims. That’s not going on,” says Bittner, who adds that DNR has received coyote reports in every Maryland county over the past few years and “we’ve not noticed any marked decline in deer.”

Smaller predators will likely feel the bite as coyote numbers grow. “I think, in general, coyotes will bring some ecological balance to natural systems by helping to control possums, raccoons, red foxes, and other mid-sized predators. That will have benefits for those animals that these animals suppress,” says Martin Main, a University of Florida biologist who studies the coyote’s march across Florida. Animals that may benefit from the coyote’s presence include ground-nesting birds such as turkey, quail, and some ducks.

Meanwhile, Fairfax County’s Hodnett hopes that coyotes will

On average, eastern coyotes weigh between 35 and 40 pounds. That’s up to twice the weight of a scrawny southwestern coyote but half the weight, at most, of a husky or German shepherd.



In the Northeast, some coyotes stay in family groups longer than their western counterparts.

David Welling

target some other large birds, namely nonmigratory suburban Canada geese (*Branta canadensis*) that soil and nest in area parks, golf courses, and school grounds. "A large Canada goose weighs 12 pounds and a fox weighs 12 pounds," says Hodnett. "A goose pair could team up on a fox, but a [heavier] coyote would have the match tipped in its favor." Like so many other questions, the goose-versus-coyote scenario is an unknown.

At a Den Site Near You...

On average, eastern coyotes weigh between 35 and 40 pounds. That's up to twice the weight of a scrawny southwestern coyote but half the weight, at most, of a husky or German shepherd. Eastern coyotes may be larger than their southwestern counterparts because the East's climatic conditions are different and its food supplies may be more abundant than those out West. Or, the size difference may be due to eastern coyotes' part-wolf heritage. Genetic testing indicates that eastern coyotes likely have a little wolf blood they picked up as pioneer coyotes passed through gray or red wolf enclaves in the Northeast and Southeast. In at least some parts of the Northeast, coyotes remain in family groups longer into winter than those in other regions. This extended social behavior, reminiscent of wolf pack behavior, enables the animals to hunt deer when smaller prey is hardest to find.

For fairly large animals, coyotes are masters at keeping a low profile. Few people see their brushy, black-tipped tail, the tan-and-gray fur, the large triangular ears, or the alert yellow eyes. Fewer still see the coyote dens carefully dug under logs or other debris or enlarged from abandoned fox, rabbit, or groundhog burrows.

In some metropolitan areas, coyotes live underfoot. Biologists found some sleeping under cars in the Chicago area. Coyotes den in culverts under the streets of Phoenix, beneath mobile homes, and in

narrow parks snaking through heavily suburbanized neighborhoods throughout the East. One was even darted and moved to a zoo after popping up in Central Park in 1999. It probably got there after crossing a downtown bridge.

In much of the eastern coyote's range, females come into heat and mate in January and February. Coyote pairs generally do not mate for life, but may stay together for a few years. In April, following two months' gestation, females give birth to a litter, which on average numbers four to six pups. At the slightest sign of danger, pups may be

moved to another den site.

By late spring, young finish six weeks of nursing, then eat food their mother regurgitates for them, followed later by solid food. Pups leave the den in mid-summer, traveling around with their parents. After learning to hunt, they help catch prey. Most juveniles strike out on their own by the end of December, although family groups in the Northeast may stay together until as late as March.

Coyotes likely use Rock Creek Park as a refuge in which to den and escape from the urban fray during the day. By nightfall, the park's coyotes—and no one currently knows how many or how few there are—disperse into local neighborhoods. The area used by a coyote for all of its activities, called its home range, varies widely from site to site. Also, breeding individuals wander far less widely than dispersing juveniles and unpaired adults. In a



As coyotes spread eastward, they likely bred with gray wolves (pictured) and red wolves, which may explain why eastern coyotes are often larger than western coyotes.

Gary Kramer/USFWS

Florida study, ten to 15 square miles was average. In the Northeast, where food can be scarcer, home ranges are often far larger. Home ranges of dispersing western coyotes may reach 65 square miles or more. So, a coyote seen in a neighborhood one night may be denning nearby, or just wandering.

Some people feel happy knowing the coyote has settled in the D.C. area. "To be witnessing a sizeable predator coming into the area, especially in light of the work that I do with deer in the county, is thrilling," says Gibbs. "We'll see how it will work out in



Bruce Coleman Inc./Erwin and Peggy Bauer

Coyotes are enterprising predators, and this one found a meal in the ground nest of a Brewer's blackbird (*Euphagus cyanocephalus*) in Montana. In the Washington, D.C., area, some birds and other wildlife could be affected by an increase in the coyote population.

the ecosystem. We used to have wolves in this area. Coyotes aren't wolves but they're the closest we'll get. Something may well come back into balance."

Others aren't so thrilled. "Some people call and are outraged that we don't have programs for trapping and hunting coyotes," says Fairfax County's Hodnett. "That's what's been going on out West for years and they've not had any more success" in controlling coyote populations.

Others take a more cautious approach. "We're taking a hard look at how we're housing some of the animals," says William Xanten, general curator of the Smithsonian's National Zoo, which is bordered by Rock Creek Park on three sides. "We're concerned. There's no doubt about that, but basically, there's not much more we can do than what we do already for foxes and raccoons. We're pretty well protected at [potentially vulnerable] places. The majority of the animals in our outdoor collection are too large for foxes or raccoons or possibly even coyotes. Birds that roost outside are protected by hot wires or total enclosures," he says.

National Zoo Senior Scientist John Seidensticker grew up in coyote country, in Montana, and is skeptical that coyotes will be a benign addition to the Zoo property and adjoining Rock Creek Park. "The bottom line is that we just don't know [much about these new predators]. They are a new element to the eastern fauna. But they won't regulate themselves within Rock Creek Park," he says. "You're never going

to have large-scale natural processes in this small-scale place. Coyotes will be very effective in invading surrounding communities."

Whether you love or hate them, coyotes seem here to stay, something that Ferebee and I agree on as we look down at whitish tufts of fur scattered at our feet. We're now standing beside a convenience store-sized mulch pile at the edge of the forest. "We took a deer carcass off the road and put it here, then put out a camera," Ferebee tells me. "We got foxes and coyotes on the same roll of film, so they're coexisting for now." Ferebee adds that he's not seeing as many red foxes as he used to, and when he shines lights into the park's woods to count deer, he's starting to see coyotes too.

Back at his office, Ferebee shows me the photos snapped at the spot where the fur now sits. There's a carrot-orange red fox peering into the camera, followed by shots of two tawny-and-gray coyotes standing over the carcass. The robust coyotes seem as if they've always lived in this forest. "By the third roll," Ferebee says, "they seemed to be a lot more wary." Later pictures show the coyotes farther back, more hindquarters and bottlebrush tails than anything else. But they apparently were not giving up on the carrion, despite the annoying flashes. "Right after we took the camera away, the carcass disappeared," says Ferebee. "They dragged it away." Z

—Contributing editor Howard Youth's last ZooGoer article focused on Florida's introduced reptile fauna.



Polar bears in Hudson Bay, Canada, wait along the edge of sea ice, waiting for seals to surface. As temperatures in Hudson Bay rise, the ice cover decreases, leaving the bears without the means to feed themselves.



BY MARY-RUSSELL ROBERSON

Disappearing BY DEGREES

Along the western coast of Hudson Bay in Canada, female polar bears (*Ursus maritimus*) and their new cubs come out of their dens in late February or early March. The mama bear hasn't eaten in about eight months. If she and her nursing cubs are to survive, she must get food and get it fast. Food means seals, and the place to get seals is out on the sea ice. The female keeps her cubs near

the den for a few days so they can practice walking, then she leads them toward Hudson Bay.

"She's gonna get out there and try to kill as many seals as she can," says Andrew Derocher, a polar bear researcher and professor of biological sciences at the University of Alberta. "If she doesn't get enough to eat, soon she'll stop nursing and the cubs will expire very quickly."

Although polar bears can swim, they rarely hunt in open water. Instead, they wait patiently on the edge of the ice for a seal to come up for air. For the first few weeks after females and cubs arrive on the sea ice, hunting can be difficult. Adult seals are experienced in the ways of evading hungry polar bears. But in April, ringed seal pups (*Phoca hispida*) and bearded seal pups (*Erignathus barbatus*) are weaned and take to the sea. These six-week-old pups weigh more than 200 pounds (almost as big as adults) and are about 50 percent fat. "They are like huge fat packets," says Nick Lunn, a research scientist with the Canadian Wildlife Service. "Polar bears have this opportunity with all these naive young seal pups out there. It's a feast—like kids in the candy store."

For the next two to three months, polar bears eat seals and build up their fat reserves. No one has yet quantified exactly how important this spring feast is to the western Hudson Bay bears, but Derocher estimates that the bears take in 70 to 80 percent of their yearly caloric allotment from April to June. When the ice on the bay breaks up and melts, the bears come ashore. Females and their cubs go farther inland and stay out of the way of potentially aggressive males, which keep closer to the coast. During the summer, bears may eat a few berries here or there but for the most part, they fast, living off the fat reserves they built up during the spring seal feast. In the fall, all the bears except the pregnant females, which are holed up in dens, head back out on the ice.

The spring feast is especially important for females that are nursing last year's cubs, and for pregnant females. Nursing females must consume enough to sustain not only themselves, but their cubs as well. And pregnant females, after mating in the spring, will gestate, bear, and nurse their cubs over a period of more than eight months in a den on land, and go without eating while other polar bears are out hunting seals.

The ice in Hudson Bay typically begins to break up sometime in May or June; the bay is usually ice-free by late July or early August. The timing varies from year to year depending on the weather. Derocher and Lunn, working with Ian Stirling of the Canadian Wildlife Service, have found that when the ice breaks up early, bears come ashore in poorer condition, with less fat than usual. Females give birth to fewer cubs and the cubs are smaller and less likely to survive. When the ice breaks up later, bears come ashore in better

condition and females produce more and larger cubs. A female in really good condition might weigh 900 pounds, of which 450 pounds might be fat.

An example of a good year was 1992. That year was particularly cold, because the June 1991 eruption of Mt. Pinatubo in the Philippines spread tons of sulfuric acid particles, which reflected heat from the sun, around the Earth's stratosphere. An El Niño event also helped keep temperatures down. The ice in Hudson Bay broke up three weeks later than average, and bears were in very good condition when they began their summer fast. As a result, more cubs than usual were born and survived in 1992 and 1993. Researchers still call those bears Mt. Pinatubo bears.

"The bears come ashore in poor condition because they haven't had as much opportunity to feed."



Polar bears feast on seals in the spring, building up fat reserves they need to survive the rest of the year.

Gerald and Buff Corsi/California Academy of Sciences

A population of polar bears can survive a bad year or two. But lately, there have been more bad years than good for some bears. Researchers have discovered a trend in western Hudson Bay of earlier and earlier breakup. On average, the ice breaks up 2.5 weeks sooner now than 30 years ago. Earlier breakups cut short the spring feast that is so important to the yearly cycle of the Hudson Bay bears.

The bears are indeed losing weight. Canadian researchers have been studying the western Hudson Bay polar bear population for more than 30 years and have seen the condition of the bears decline. "Condition" is quantified with a formula that includes the bears' length and weight—it's very similar to the body mass index (BMI) used for humans. The weight used in the formula is adjusted to account for the fact that the bears may be fasting and losing

weight when they are caught and measured. If a bear is caught before September 1, the scientists subtract 0.85 kg (or 1.87 pounds, which is the amount typical polar bears lose per day during fasting) from its weight for each day before September 1. Conversely, for bears caught after September 1, the researchers add 0.85 kg per day. The body condition index is averaged for bears of different age classes and sexes, and used to make comparisons from year to year. From the early 1980s to the early 2000s, Lunn says, the condition of female polar bears in western Hudson Bay has declined by 15 to 20 percent.

"The bears come ashore in poor condition because they haven't had as much opportunity to feed, and we're asking them to turn around and go into their fasting state earlier," Derocher says. "It's a double-edged sword; they're being cut on both sides."



Bruce Coleman Inc./D. Robert Franz

Studies show that Hudson Bay cubs suffer increased mortality rates when rising temperatures cause early ice breakups. Without proper time to hunt and build up fat stores, females cannot nurse their offspring, and the cubs starve.

When the condition of females declines, cubs suffer. “As the female starts to lose her nutritional status, she stops nursing,” Derocher says. “The cubs have very little in the way of body fat—they quickly burn off their stores and die quite easily.”

Lunn and others are in the midst of a polar bear census in western Hudson Bay. While the work is not yet complete, Lunn says the numbers so far suggest that the population size has fallen since censuses of the mid-1980s and mid-1990s. He says, “We’ve seen differences. We don’t seem to see the same number of adult females and cubs as we used to in denning areas. The adult females and cubs we find tend to be closer to the coast than they used to be, perhaps because there are not as many males near the coast as there used to be. We’re not seeing adult males in the same numbers as we used to. There are more problem bears in and around Churchill. Things are changing. It’s clear something is going on in the Hudson Bay ecosystem.”

What’s going on is likely to continue if, as researchers believe, climate change is the driving force behind the changes.

Average air temperatures on Earth are increasing. Since the start of the Industrial Revolution in the mid-1800s, global temperatures have risen an average of 0.6°C (1.1°F), according to the report of the Arctic Climate Impact Assessment published in 2004. This report was the result of the work of hundreds of scientists from all over the world.

The overwhelming consensus among scientists is that these temperature increases are due primarily to man-made emissions of cer-

tain “greenhouse” gases, such as carbon dioxide. Greenhouse gases trap the heat of the sun in our atmosphere. Burning fossil fuels is the main way humans add greenhouse gases to the environment. Before the Industrial Revolution, the concentration of carbon dioxide in our atmosphere was about 280 parts per million. Today it’s between 360 and 380 parts per million. That’s a 35 percent increase in about 150 years.

Temperatures are not increasing evenly all over the globe, because factors that affect climate vary from place to place. Topography, wind patterns, ocean currents, and reflectivity of the surface, to name just a few, all affect climate. In the past few decades, temperatures in the Arctic have increased almost twice as fast as the rest of the world. One reason for this is that as ice and snow melt, they reveal darker soil or water underneath, which tends to absorb the sun’s heat rather than reflect it as ice and snow do.

John Walsh, a professor of atmospheric science spending a sabbatical at the University of Alaska in Fairbanks, did a study of average annual temperatures north of 50°N—the latitude of Prague and Winnipeg. He found that between 1943 and 2002, temperatures of coastal regions increased by an average of 0.4°C (0.7°F) and the temperatures of inland regions increased 0.8°C (1.4°F). Within those averages, there is quite a bit of variation. For example, the northern coast of Alaska has warmed 2°C (3.6°F) since 1973.

Western Hudson Bay is one of the areas where temperatures have

Baffin Bay Narwhals, OUT IN THE COLD



In recent decades, cooler-than-usual temperatures in narwhals' wintering grounds caused an increase in ice on the sea in Baffin Bay. If the trend continues, narwhals may not be able to find openings in the ice and come up for air.

The narwhals (*Monodon monoceros*) of Baffin Bay have a very different problem than polar bears do. In the past several decades, there has been an increase in surface ice on Baffin Bay during the winter. This puts narwhals at risk because, like all whales, they must periodically surface to breathe.

Global warming does not produce even heating all over the Earth, and Baffin Bay, which is between Greenland and Canada, is actually cooling slightly. Satellite data collected over the last two and a half decades shows a trend toward increasing ice coverage of the bay. Climate change models predict that this trend could continue for the next 50 years.

At least 85 percent of the world's narwhals spend their winters in Baffin Bay. In the fall, about 50,000 narwhals migrate south from the high Arctic to two separate parts of Baffin Bay—the northern wintering grounds and the southern wintering grounds. There they spend six months gorging on fish, primarily the Greenland halibut (*Reinhardtius hippoglossoides*). Scientists believe that this winter feeding supplies the whales with the majority of their annual caloric intake.

When the whales arrive at their wintering grounds in late October or early November, about 40 percent or less of the surface is covered with ice. As the winter progresses, however, more and more of the surface freezes. Kristin L. Laidre, a post-doctoral research scientist, and Mads Peter Heide-Jørgensen, a senior scientist, both with the Greenland Institute of Natural Resources in Nuuk, Greenland, have studied satellite data from 1978 to 2001. They found that, on average, by mid-January, no more than 5 percent open water remains in both wintering grounds. By the end of March, on average, there is only 2 percent open water in the southern wintering grounds and only 0.5 percent open water in the northern wintering grounds.

With such a small fraction of the surface available for breathing, narwhals are very vulnerable to even small increases in ice. It might seem to the casual observer that male narwhals could use their long tusks to break breathing holes in the ice, but in reality they are unable to do so, and narwhals must breathe wherever they can find a natural opening. In severe cold snaps, hundreds of narwhals have become trapped at a single

opening, and many of them eventually died as a result. If the amount of ice cover continues to increase, these "ice-entrapment events" could become more common.

Narwhals could avoid the problem by migrating farther south in Baffin Bay, where there is less ice. However, narwhals show remarkable fidelity to their wintering grounds, returning to the same location year after year, despite the lack of landmarks in the open water. In the past, narwhals did not alter their migration routes even when faced with intense hunting by indigenous populations, so it appears that they do not change their travel paths or destinations based on outside stimuli. Furthermore, there is always plenty of open water in the fall, when the whales select their wintering grounds.

Laidre notes that in the last two years, there has actually been less ice on Baffin Bay than usual. Only time will tell whether the climate models for that part of the Arctic are correct in predicting an increase in ice coverage. In the meantime, Laidre is continuing to study narwhals and keep an eye on ice trends in Baffin Bay.

—Mary-Russell Roberson

risen faster than average. May and June air temperatures in western Hudson Bay have increased at a rate of 0.2 to 0.3°C (0.4 to 0.5°F) *per decade* since 1950.

Warming temperatures in the Arctic mean less ice. Josefino Comiso, a senior research scientist at NASA's Goddard Space Flight Center, has used satellite data to study annual and perennial sea ice in the Arctic from 1978 to the present. Annual sea ice forms anew each winter, while perennial sea ice, which is on average more than ten feet thick, remains frozen all year long. Comiso has found that the amount of annual ice in the Arctic is decreasing by 2 to 3 percent each decade. The loss of perennial ice is much more dramatic. Comiso says, "The thing I think is remarkable from our studies is the fact that the perennial ice is decreasing at the rate of more than 9 percent per decade."

"If you look at this trend and try to project it into the future, the perennial ice would disappear within this century," Comiso says. "Some models project a disappearance by 2050. Some are more conservative—they go as far as the end of the century. There is quite a bit of disagreement in the models. However, they all predict declines, using the scenario of ever-increasing greenhouse gases."

And what would happen to polar bears if there were no sea ice? Polar bears evolved from brown bears into a specialized pagophilic (ice-loving) species. Their adaptations suit their ice-based lifestyle—white fur for camouflage, black skin to soak up heat from the sun, huge paws to act as snowshoes, and a lot of fat for insulation. These adaptations evolved over thousands of years. "I don't think polar bears will evolve back into terrestrial bears fast enough if the various predictions of these models come to pass and we do lose sea ice or lose it in places forever," says Lunn. "The future doesn't look good for a species that depends upon it such as polar bears."

There are an estimated 21,500 to 25,000 polar bears in the world today, living in about 20 relatively discrete populations in the Arctic. There is considerable variability in the natural history and ecology of each population. For example, bears that live in areas of perennial ice can hunt the entire year instead of fasting through the summer like the western Hudson Bay bears. Most of the 20 populations have not been closely studied; only four are considered to have good population estimates. That means there are not a lot of data about how climate change may be affecting the majority of polar bears.

The Hudson Bay bears have been studied for longer and in more depth than any other population. "The Canadian Wildlife Service has been doing research on that population since the late 1960s," Lunn says. "The value of the work is that it is such a long-term database that we are able to look at the past and the present and make comparisons between what things were like 20 or 25 years ago and what they are like now." Because there is considerable variability in the timing of breakup from year to year, meaningful patterns emerge only when decades of data are analyzed.

Another polar bear population that has been fairly closely studied is the Beaufort Sea population, which ranges on the north shore of Alaska near the city of Barrow east into Canada. This population is showing changes in distribution that appear to be linked to environmental conditions. Scott Schliebe, polar bear project leader for the U.S. Fish & Wildlife Service in Anchorage, has been studying polar bears for more than 20 years. He says of the Beaufort Sea bears, "We're finding more bears on the shore during the fall open-water and freeze-up period, and they seem to be staying there longer. In the 1980s and early 1990s, it was rare to find bears on the coast and we didn't find them in aggregations of substantial numbers like today." Schliebe and his colleagues considered a number of possibilities for the change: This population of polar bears could be growing, the distribution of seals in the area could be changing, the bears could be coming ashore to scavenge bowhead whale carcasses left behind by

There are an estimated 21,500 to 25,000 polar bears in the world today, living in about 20 relatively discrete populations in the Arctic.



Bruce Coleman Inc./Mark Newman



A polar bear surveys the ice on Hudson Bay. Perennial sea ice, which stays frozen year-round, is declining by 9 percent each year in the Arctic. Some scientific models predict that perennial sea ice may disappear entirely from the Arctic by 2050.

indigenous hunters, or retreating sea ice could be forcing the bears to move ashore. In an effort to tease out the most likely cause, scientists conducted five years of bear surveys combined with five years of ice surveys. Each year they calculated the average distance of the ice from the shore. “We found there was a relationship: The farther the ice is away from the shore, the greater the number of bears on shore, and that relationship was statistically significant. During all years, bowhead whale carcasses were a constant so we believe that ice conditions have a pretty good probability of being a contributor to this distribution change. We’re quite concerned about it.”

The Alaska Beaufort Sea population is adjacent to, and sometimes overlaps, the Chukchi Sea population, which ranges from Barrow west to Russia. There is anecdotal evidence that bears from the Chukchi Sea population have also been appearing on land more frequently than in the past. “Most research emphasis has been in the Beaufort Sea because the bears are accessible,” Schliebe says. “Bears in the Chukchi Sea are less accessible, they occupy a larger area, and a good bit of the area is in Russia. The United States signed a treaty with Russia in October 2000 for the joint conservation,

management, and study of this population, and we are waiting for the U.S. Congress to pass legislation to enable us to implement the treaty—including a program of joint research. We’re really hopeful that once Congress passes the implementing legislation we can start active management programs and work with our Russian colleagues and overcome data deficiency issues.”



Steve Amstrup/USFWS

While most of the world’s polar bears remain little-studied by scientists, those that are being studied show signs of being affected by climate change. It’s hard to avoid the conclusion that as sea ice disappears, polar bears are at risk.

Lunn says that what’s happening with the polar bears in western Hudson Bay right now is not happening to all the polar bears in the world. But, he adds, “if the various climate change and sea ice models are correct and we do lose a lot of sea ice over time, I think the things we’re seeing in western Hudson Bay now we’ll probably be seeing down the road in some of these other populations.” Z

—Mary-Russell Roberson is a writer living in Durham, North Carolina. Her daughter’s favorite animal is the polar bear.

Books, Naturally

Bees in America: How the Honey Bee Shaped a Nation

Tammy Horn. 2005. The University Press of Kentucky, Lexington. 333 pp., hardbound. \$27.50.

Letters from the Hive: An Intimate History of Bees, Honey, and Humankind

Stephen Buchmann with Banning Repplier. 2005. Bantam Books, New York. 276 pp., hardbound. \$24.

Robbing the Bees: A Biography of Honey, The Sweet Liquid Gold That Seduced the World

Holley Bishop. 2005. Free Press, New York. 325 pp., hardbound. \$24.

Sweetness & Light: The Mysterious History of the Honeybee

Hattie Ellis. 2004. Harmony Books, New York. 244 pp., hardbound. \$23.

Bees in America will most appeal to American history buffs, who may be surprised to learn how bees, honey, and beekeepers figure in events, prominent and obscure, that shaped our nation. Much of what you will learn is, in the author's word, esoteric (and I would add, to say the least), but that is part of this book's charm. Writer Tammy Horn finds a role for bees and honey in everything from their symbolic value in defining the American dream based on the beelike values of work, thrift, and efficiency, to their inspiration of musicians such as Muddy Waters, whose "Honey Bee" is a blues standard, and poets such as Sylvia Plath, whose father was a beekeeper. According to one story, George Washington credited bees with "saving America" after a quick-witted girl caused her bees to attack British soldiers so she could get away from them and warn the Revolutionary army of an impending attack. (This was not the first time bees were enlisted in the cause of war—in fact, loosing bees is an ancient form of biological warfare.) Horn even points to a growing ecotourism niche called apitourism—visiting bee farms for pleasure!

In *Robbing the Bees*, Holley Bishop, an amateur beekeeper and honey gourmet, follows a year in the life of a Florida professional beekeeper while offering a wide-ranging survey of the biology of honeybees, the long human history of honey harvesting and beekeeping, and the diverse uses of honey, wax, and other products of the hive. *Robbing the Bees* is replete with fascinating facts. For instance: In about three weeks of active foraging, a worker bee will travel some 500 miles before she dies after a total lifespan of about six weeks. While

in its egg and larval stage, each bee is fed about 10,000 separate pollen meals by many different nurse bees. The first record of honey hunting dates to 6000 B.C.E., in a petroglyph from Spain depicting a method of honey collecting that is still practiced today in parts of Asia and Africa. Fermented honey—mead—was the intoxicating beverage of choice long before wine and other spirits. Honey is a preservative as well as an antibiotic. Long a staple of folk medicine, modern studies are demonstrating its efficacy in controlling skin infections—Bishop calls it the "world's first self-adhering Band-Aid."

Stephen Buchmann covers much of the same ground in *Letters from the Hive* but includes a tasty sampler of the many varieties of honey, recipes and tips for cooking with honey, and, appropriately for a professor of entomology, an overview of bees of the world. Alone among these busy writers about bees, he also explores the decline of stingless bees, both wild and husbanded, in the Yucatán. These bees traditionally provided honey to the Maya, but declined thanks both to deforestation and the arrival of Africanized honeybees, "which take the lion's share of floral nectar, making it difficult for stingless bees to make a living."

Hattie Ellis is an "apitourist" who begins *Sweetness & Light* in the English countryside, where she accompanies a beekeeper harvesting his honey, and ends it in Chicago, where bee hives grace the roof of city hall; and New York, where city officials have banned urban beekeeping; with stops in Sicily, Greece, and even New Zealand along the way. Ellis' book, relating much of the same infor-

mation as the others, is the most beautifully written of the four. She wonderfully describes how the bees respond to a suited-up honey thief: "The bees . . . go purposefully berserk. Zinging, small, aggressive atoms, gold in the late-afternoon sun, attacking again and again from different angles, trying to find a way into the bee suit. Their persistence is unrelenting." And here she defines honey: ". . . bees perform an act of alchemy. Honey is nothing less than concentrated nectar; and a pot of good honey is the essence of its surroundings, a sweet, fragrant river from a million tributaries, carried across the air and flowing gold into the pot through the transforming power of bees."

But, as Ellis reports, in medieval Europe, beeswax for candles was the far more valuable product of the hive. Her title alludes to this, and comes from Jonathan Swift, who wrote, "We have chosen to fill our hives with honey and wax; thus furnishing mankind with the two noblest of things, which are sweetness and light."

Many more things we value are gifts from the bees too. Choose any one of these sweet books and read all about it.

—Susan Lumpkin



BioAlmanac

by Deborah Press

Reef Racket Calls Fish Home

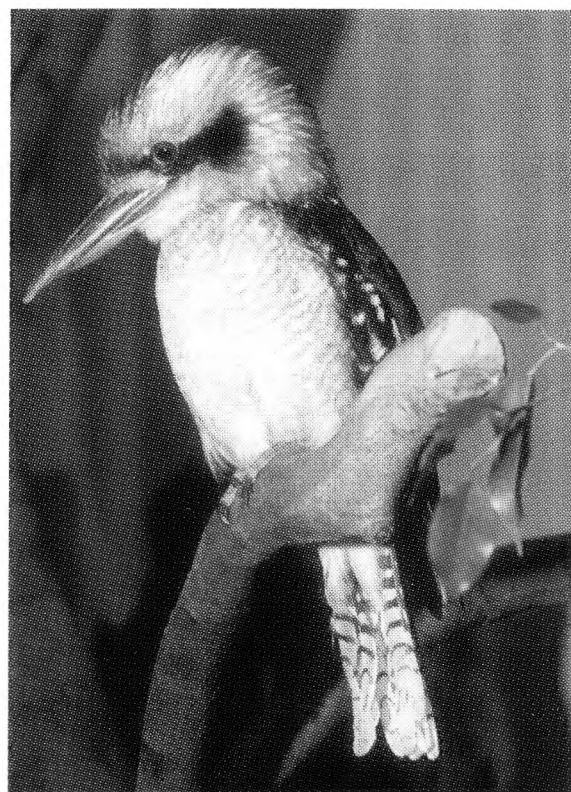
In the animated Disney film *Finding Nemo*, an overprotective clownfish (*Amphiprion* sp.) forbids his young son to leave the safety of the reef and venture into open waters, where untold perils await. But in reality, most baby reef fish spend their first few weeks or months in open water, where predators are few. Once the small fry become accomplished swimmers, they choose a reef and settle down.

But how do they find their new homes? A study published in the April 8, 2005, issue of *Science* suggests that sounds orient larvae to prime reef real estate. A team of scientists, led by an ecologist from the University of Edinburgh, built 24 artificial reefs near Australia's Great Barrier Reef. They broadcast recordings of common reef sounds—shrimp claws snapping and fish grinding their teeth or vibrating their swim bladders—from loudspeakers on half the reefs, and nothing from the other half. A significantly greater number of reef fish, including damselfish (family Pomacentridae) and cardinalfish (family Apogonidae) larvae, settled on the noisy reefs. The study could help determine whether human-made noises, such as boating or underwater drilling, interfere with the larvae's reef selection, and may help conservationists develop auditory lures to attract reef fish to protected marine reserves.

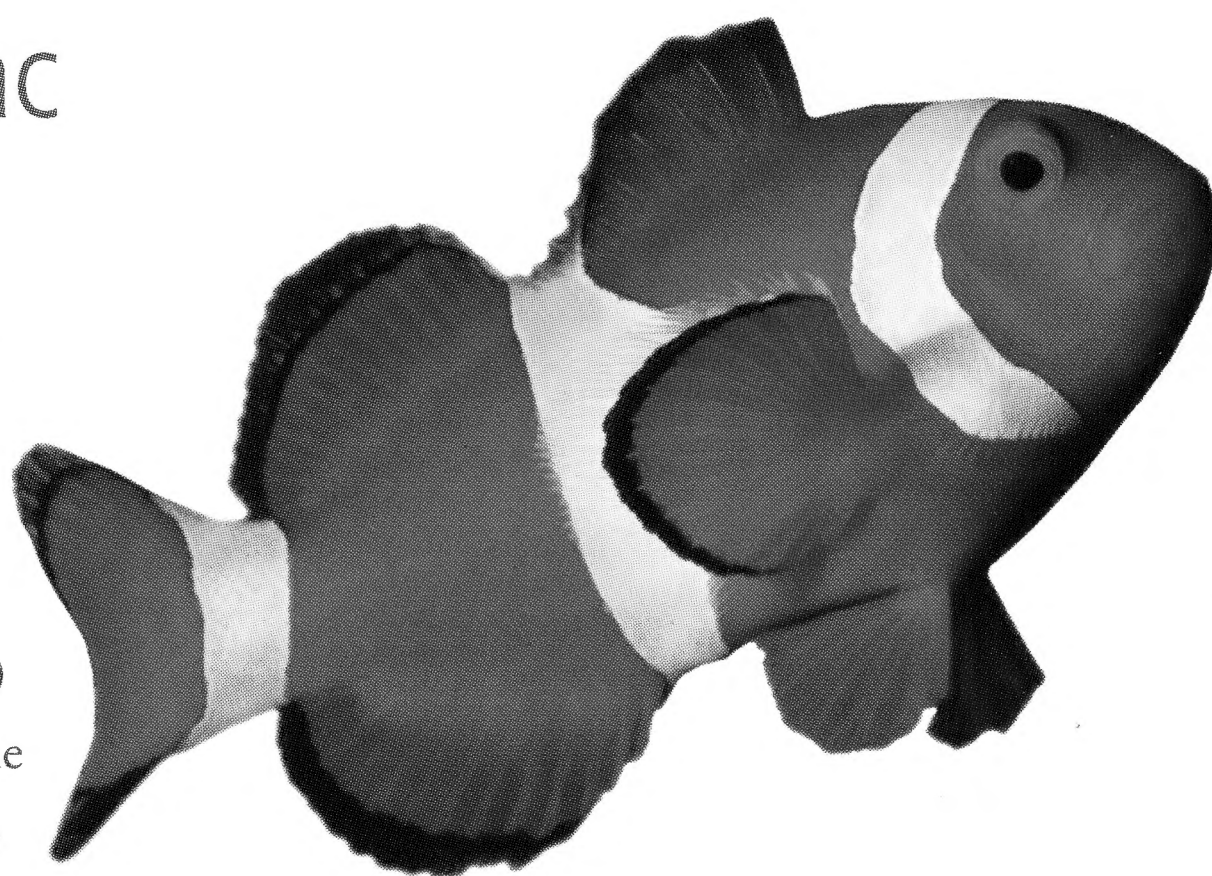
What's in a Name?

When the forest rings with birds' laughter, don't assume the birds are happy, despite what their names imply. The laughing falcon (*Herpetotheres cachinnans*) of Latin America is dubbed for its seemingly mirthful vocalization—*cachinnans*, the bird's species name, comes from the Latin *cachinnare*, meaning to laugh aloud or guffaw—but its laughter is usually a sign that it's being disturbed. In Costa Rica, the laughing falcon is known as the *guaco* in onomatopoeic tribute to its twilight call—repeated utterings of the sound "gwa" that gradually build in intensity until exploding into an emphatic salvo of "gwa-co" lasting for several minutes.

Another chuckling avian, Australia's laughing kookaburra (*Dacelo novaeguineae*), ushers



in the new day with a clamorous staccato chorus, earning it the nicknames alarmbird, breakfastbird, and bushman's clock. In Aboriginal folklore, the laughter of the kookaburra rouses the sky people each morning to kindle the sun's daily fires. Ornithologists, more prosaically, explain the raucous call as a territorial song. The word kookaburra is of imitative origin, deriving from the Wiradhuri (an Aboriginal language of southeast Australia) word for the bird, *gugubarra*. The kookaburra's laugh begins with a soft chuckle and then bursts into a maniacal "ha-ha-ha-HA-HA-hoo-hoo-hoo." The laughing owl (*Sceloglaux albifacies*), laughing gull (*Larus atricilla*), and several species of laughing thrush also fill the air with wild laughter.



Do Animals Behave Differently During a Full Moon?

The full-moon-inspired lunacy that affects animals in myths and horror movies has yet to withstand scientific scrutiny. But some animals do react to a full moon in a highly rational, and far less dramatic, manner. Nocturnal mammals such as some rodents, hares, badgers, and bats make fewer movements and vocalizations and limit their forays into open spaces during a full moon, most likely to avoid predators that spot and hunt prey more successfully on well-lit nights than on dark ones.

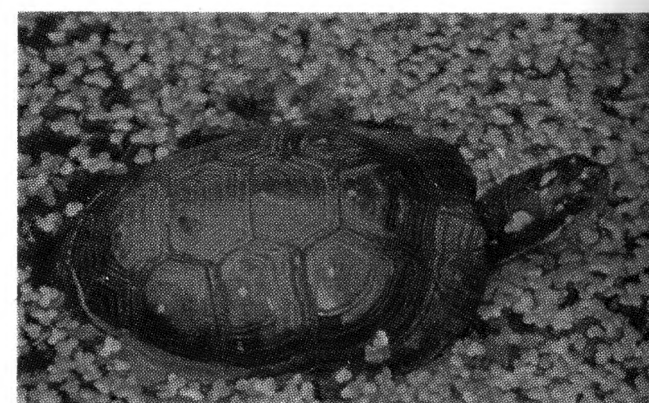
In the Southwest U.S., nocturnal Merriam's kangaroo rats (*Dipodomys merriami*) usually forage for food at night, except during periods of bright moonlight, when they stay in their burrows to avoid owls, rattlesnakes, and coyotes. They then emerge to feed at twilight, paradoxically exposing themselves to diurnal predators.

Fact or Fiction: Mules Are Stubborn

These sure-footed, sensible animals have long been maligned by the adage "stubborn as a mule." In truth, mules—the offspring of female horses and male donkeys—are merely committed self-preservationists. When a mule perceives a hazard that a human handler has overlooked, it will refuse to endanger itself. Mules have greater endurance than horses and can work longer without food or water, but upon reaching their physical limits, mules will not budge until sufficiently rested. Similarly, a mule may reject its rider's preferred route of travel for a safer path of its own choosing. Maybe, one day, the phrase "independently pragmatic and conscientious as a mule" will catch on.

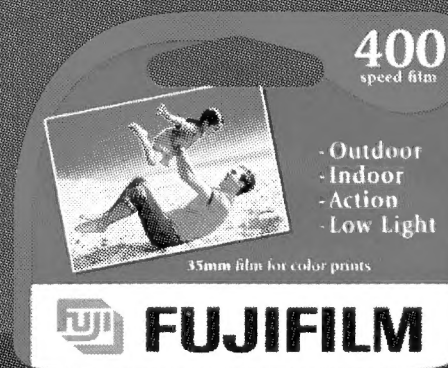
In Season

During those steamy summer months when Northerners bake on the beach, another eastern resident, the spotted turtle (*Clemmys guttata*), takes a cool, dark vacation. After their spring breeding season has passed and they have deposited eggs in their shallow wetland habitats, these yellow-flecked turtles become inactive during the late months of summer. They burrow under forest leaf litter, keep house in mammal burrows, or chill out in pools of running water to prevent desiccation and overheating. This state of summer torpor, called estivation, may also help the spotted turtle conserve energy and avoid predators.



There are more species of beetle than of any animal in the world. Of the approximately 1.7 million animal species currently described by scientists, one in four is a beetle.

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